ASTR 5820: Origin and Evolution of Planetary Systems

http://jilawww.colorado.edu/~pja/astr5820/

TIME & PLACE: Tuesday / Thursday 12:30 am – 1:45 pm, Duane E126

INSTRUCTOR: Phil Armitage (pja@jilau1.colorado.edu; office JILA A909; phone 2-7836). There are no official "office hours" for this class, you're very welcome to stop by at any time. I'm normally in the office most afternoons / early evenings (2-6pm). Call or email if you want to be *certain* that I'm in before climbing the JILA tower.

AIMS: The observational study of extrasolar planets, together with the theoretical mysteries posed by the fact that many extrasolar planetary systems look very different to the Solar System, are two of the most rapidly developing fields in astrophysics. Equally important has been a revolution in our understanding of the early history of the Solar System, driven in part by the discovery of the Kuiper Belt, that yields clues as to the relation between our Solar System and others. The main goal of this class is to give an introduction to the formation and evolution of planetary systems, and how the theory of how planets form is related to local and extrasolar planetary system observations. A second goal is to give you practice at defining and solving "near research-grade" problems, writing papers and giving technical presentations.

OUTLINE:

1. Introduction: The Solar System, detection and basic properties of extrasolar planetary systems.

2. Protoplanetary disks: origin within the larger star formation picture, structure of passive and active disks, evolution of disks as accretion flows, sources of angular momentum transport within disks.

3. Planet formation: evolution of dust, formation of planetesimals, terrestrial planets and giant planets.

4. Early evolution of planetary systems: mechanisms for dynamical evolution (stability, chaos, scattering), planet-disk interactions, and tides.

TEXTBOOKS: No textbook is required for the class. Most of the technical material (definitions, derivations etc) is covered in lecture notes that I prepared for previous iterations of this class (http://arxiv.org/abs/astro-ph/0701485), and that I'll hand out at the first class. I updated these notes last summer, so they're more current than most other references. I'll recommend that you read sections of the notes ahead of time each week, so we can spend more time discussing the scientific issues and less simply copying down equations! Several textbooks are also available, and if you're the sort of person who appreciates a more "structured" presentation it may be worth getting one. I'd recommend:

- *Astrophysics of Planet Formation* (Philip J. Armitage, Cambridge University Press). Written by me, and based on this course. Obviously I'm somewhat biased about its merits…
- *Exoplanets* (edited by Sara Seager, University of Arizona Press). Not a textbook per se, but a *very well chosen* set of review articles covering planet formation, planet detection and planetary structure.
- *Planetary Science* (Imke de Pater and Jack Lissauer, Cambridge University Press). Not much on planet formation, but this is the standard reference for a survey course on planetary science at the graduate level. You'll want the second edition.
- *Solar System Dynamics* (Carl Murray and Stan Dermott). What it says on the box. Very few people need to know as much about analytic planetary dynamics as this, but if you do, this is the definitive reference.

ABSENCES: I will be out of town on a number of occasions during the semester, on Feb 3 / 5 (colloquium in Zurich), Feb 17 (colloquium at Princeton), Mar 17 / 19 (winter school lectures), and Apr 30 (NSF review). When it makes sense, I may have guest lecturers cover for me, but primarily I plan to make up the missed classes at a time that works for all of us. It's a small class, so hopefully this will be possible.

If *you're* away – observing, at conferences, etc – that's no problem. Just let me know.

EVALUATION: Grading is *not at all* the main purpose of a graduate class, but we do have to do it. We will have problems sets (50%), a take-home midterm (20%, provisionally on Mar 17), and a final project (30%). The project will be the main activity after Spring Break.

QUERIES: I plan to spend a decent amount of time covering each of the four "themes" outlined above. The topics we cover, however, are not set in stone, and can be changed if there's particular interest in some specific problem or observation. Just ask!

THE FINE PRINT:

If you qualify for accommodations because of a disability, please submit to me a letter from Disability Services in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities. Contact: 303-492-8671, Center for Community, N200, and http://www.colorado.edu/disabilityservices.

Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class, just inform me of any potential conflict.

Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, color, culture, religion, creed, politics, veteran's status, sexual orientation, gender, gender identity, and gender expression, age, disability, and nationalities. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records.

The University of Colorado at Boulder Discrimination and Harassment Policy and Procedures, the University of Colorado Sexual Harassment Policy and Procedures, and the University of Colorado Conflict of Interest in Cases of Amorous Relationships Policy apply to all students, staff, and faculty. Any student, staff, or faculty member who believes s/he has been the subject of sexual harassment or discrimination or harassment based upon race, color, national origin, sex, age, disability, creed, religion, sexual orientation, or veteran status should contact the Office of Discrimination and Harassment (ODH) at 303-492-2127, or the Office of Student Conduct (OSC) at 303-492-5550. Information about the ODH, the above referenced policies, and the campus resources available to assist individuals regarding discrimination or harassment can be obtained at http://www.colorado.edu/odh.